SUPPORT FOR THE AMENDMENTS

Claims 1-3, 5, 6 and 8-18 are pending. Claim 1 is currently amended. Claims 4 and 7 are canceled without prejudice. Claims 8-18 are added. Claim 1 is currently amended to include the subject matter of original claim 4. New claim 8 is original claim 7 rewritten in independent form. New claims 9-12 find support in original claims 2, 3, 5 and 6 respectively. New claim 13 finds support in original claims 1, 4 and 7. New claims 14-17 find support in original claims 2, 3, 5 and 6 respectively. New claim 18 and the specification amendment find support in the original specification: page 18, lines 12-20. No new matter has been entered.

REMARKS/ARGUMENTS

Claims 1 and 3-6 are rejected under 35 U.S.C. §103(a) as obvious in view of *Kuroda et al.* (US 6,372,056). Claim 2 is rejected under 35 U.S.C. §103(a) as obvious in view of *Kuroda et al.* and *Tsukamoto* (US 5,156,692). Claim 7 is rejected under 35 U.S.C. §103(a) as obvious in view of *Kuroda et al.* and *Bae et al.* (US 6,264,759). Applicants respectfully traverse these rejections.

The current invention relates to hot-rolled wire rods useful in the production of high-strength steel wires. Historically, steel wires or the like have generally been produced through the processes of: hot-rolling a high-carbon steel; cooling the resulting steel wire rod; successively subjecting the wire rod to primary wire drawing, patenting treatment, secondary wire drawing, optionally a secondary patenting treatment, plating and blueing treatment; and then finally applying wet wire drawing (finish wire drawing) to obtain a prescribed wire (specification: page 2, lines 4-15). Among the above processes, the patenting treatment (annealing treatment) is applied in order to obtain a fine pearlite structure that is beneficial to wire drawability (specification: page 2, lines 15-18). However, it has been desired to obtain a hot-rolled wire rod that is capable of omitting heat treatment (e.g., patenting or the like) while maintaining good wire drawability, resulting in improved productivity, enhanced energy saving, and reduced costs (specification: page 2, lines 18-23). Applicants' invention has met this desire.

Applicants' claimed invention is a hot-rolled wire rod that has excellent wire drawability and allows heat treatment prior to wire drawing to be omitted (specification: page 1, lines 7-10). Additionally, the hot-rolled wire rod according to the present invention shows, over the entire length, not only tensile strength of a properly controlled average value and low variation, but also reduction of area of a high average value and low variation (specification: page 1, lines 10-14). Moreover, Applicants' hot-rolled wire rod breaks far

less frequently than a conventional wire rod even when it is processed right after hot-rolling with heat treatment such as patenting treatment or the like omitted (specification: page 4, lines 19-25).

Claims 1-3, 5, 6 and 8-17

Applicants' independent claims (1, 8, 13) have been amended from having the transitional phrase "comprising" to "consisting essentially of" (e.g., see claim 1). M.P.E.P. §2111.03 states:

> The transitional phrase "consisting essentially of" limits the scope of a claim to the specified materials or steps "and those that do not <u>materially</u> affect the <u>basic</u> and <u>novel</u> characteristic(s)" of the claimed invention. *In re Herz*, 537 F.2d 549, 551-52, 190 USPQ 461, 463 (CCPA 1976) (emphasis in original)

The M.P.E.P. elaborates further with reference to *AK Steel Corp. v. Sollac*, 344 F.3d 1234, 1240-41, 68 USPQ2d 1280, 1283-84 (Fed. Cir. 2003):

> Applicant's statement in the specification that "silicon contents in the coating metal should not exceed about 0.5% by weight" along with a discussion of the deleterious effects of silicon provided basis to conclude that silicon in excess of 0.5% by weight would materially alter the basic and novel properties of the invention. Thus, "consisting essentially of" as recited in the preamble was interpreted to permit no more than 0.5% by weight of silicon in the aluminum coating.

In accordance with the foregoing, Applicants' assert that mass % values of C, Si, Mn, P and S outside the ranges as claimed (e.g., see claim 1) would materially alter the basic and novel properties of the presently claimed invention. More specifically, the current specification elaborates on each of these elements individually, starting on page 12, line 25, to page 14, line 16, as reproduced below:

- "C is an element indispensable for securing a strength required of a wire rod and C of 0.6% or more is added accordingly. A C content is preferably 0.65% or more, yet preferably 0.7% or more. On the other hand, when a C content exceeds 1.0%, it becomes difficult to inhibit pro-eutectoid cementite, which functions as origins of wire breakage, in the cooling process after hot-rolling. A preferable C content is 0.95% or less." (page 13, lines 8)

- "Si is an element that increases the strength of ferrite in pearlite and contributes to the adjustment of strength and is also useful as a deoxidizing agent. In order to exhibit such functions effectively, Si must be added by 0.1% or more and a preferable Si content is 0.12% or more. In contrast, when Si is added excessively, the ductility of ferrite in a steel is deteriorated and wire breakage is likely to occur. For that reason, the upper limit of an Si content is set at 1.5%, and a preferable Si content is 1.3% or less." (page 13, lines 10-19)
- "Mn is an element useful for securing the hardenability of a steel and enhancing the strength thereof. Mn of 0.3% or more (preferably 0.35% or more) is added in order to exhibit such functions effectively. In contrast, when Mn is added excessively, segregation occurs during cooling after hot-rolling and a supercooled structure, such as martensite, detrimental to wire drawability tends to form. For that reason, the upper limit of an Mn content is set at 1.0%. A preferable Mn content is 0.8% or less." (page 13, line 21, to page 14, line 2)
- "P is an element that deteriorates the toughness and ductility of a steel and hence the upper limit thereof is set at 0.02% in order to prevent wire breakage in the processes of wire drawing and subsequent stranding. A P content is preferably 0.01% or less, yet preferably 0.005% or less." (page 14, lines 4-9)
- "S, like P, is an element that deteriorates the toughness and ductility of a steel and hence the upper limit thereof is set at 0.02% in order to prevent wire breakage in the processes of wire drawing and subsequent stranding. A P content is preferably 0.01% or less, yet preferably 0.005% or less." (page 14, lines 11-16)

Clearly these statements found within Applicants' current specification provide a showing of "materially affecting the basic and novel characteristics of the claimed invention" as was determined in *AK Steel Corp. v. Sollac* with similar statements. In view of the foregoing, one could argue that a showing of "materially affecting the basic and novel characteristics of the claimed invention" is equivalent to, if not greater than, a showing of criticality of a result-effective variable as described in M.P.E.P. §2144.05. Accordingly, and in view of *Kuroda et al.'s* disclosure of overlapping (not co-extensive) C, Si, Mn, P and S ranges, Applicants have rebutted the alleged "*prima facie* case of obviousness based on overlapping ranges by showing the criticality of the claimed range" (see M.P.E.P. §2144.05, Part III, first paragraph). Thus, *Kuroda et al.* does not render obvious Applicants claims.

Furthermore, *Kuroda et al.* disclose tensile strengths but only as "MPa: maximum" (see Tables 2 and 4). *Kuroda et al.* is silent with respect to average tensile strength values (TS_{AV}) and a standard deviation of tensile strength (TS_{σ}), both being measured along a single wire rod (4m long) as claimed by Applicants. Additionally, even though an average value of

reduction of area (RA_{AV}) can be calculated for *Kuroda et al.* being > 35%, the corresponding standard deviation of those reduction of area values is not $\leq 4\%$ as required by Applicants' claims (*Kuroda et al.* Table 2: 9-24% deviation). Thus, *Kuroda et al.* alone does not disclose or suggest all of the limitations of Applicants' claims; therefore, *Kuroda et al.* does not render the current claims obvious.

In view of the deficiencies of the disclosure of *Kuroda et al.* as discussed above, *Tsukamoto* and *Bae et al.* will be addressed below with respect to fulfilling these deficiencies. *Tsukamoto* discloses TS and RA values in Table 1 that could be considered to overlap with those claimed by Applicants; however, the only overlapping values are those found under the heading "starting wire" (not "drawn wire (filament)"). As explained in *Tsukamoto*, the starting wire has a diameter of 2.3 mm, is produced by cold-drawing from a hot-rolled wire rod, and is not the same as the final drawn wire subjected to thermo-mechanical treatment (see column 7, lines 30-38; and column 3, lines 63-68). Thus, one cannot compare the mechanical properties of a "starting wire" of *Tsukamoto* having a diameter of 2.3 mm with Applicants' hot-rolled wire rod having a diameter of 5.5 mm. Furthermore, even if one were able to compare the two, which they cannot, Tsukamoto remains silent with respect to TS_σ and RA_σ. Therefore, *Tsukamoto* does not disclose or suggest the limitations of Applicants' claims (namely: TS, RA, TS_σ and RA_σ). Accordingly, *Tsukamoto* does not fulfill the deficiencies of *Kuroda et al.* and the combination of the two references therefore does not render obvious Applicants' claims.

With respect to *Bae et al.*, Tables 1-3 disclose TS and RA values but are silent with respect to TS_σ and RA_σ. Furthermore, the values of TS and RA are measured in a wholly different manner and are therefore non-comparable. For instance, Applicants' mechanical properties are measured according to the specification: "A practical procedure may be done by sampling a wire rod 4 m in consecutive length arbitrarily from a whole wire rod coil,

taking 16 pieces (n=16) of JIS #9B test specimens consecutively from the sampled wire rod, and measuring the mechanical properties of the test pieces." (see [0036] of publication). In contrast, *Bae et al.* measures TS and RA for one sample wire each produced by changing the production conditions. Thus, one cannot directly compare the mechanical properties of *Bae et al.* with those required by Applicants' claims. Accordingly, *Bae et al.* do not fulfill the deficiencies of *Kuroda et al.* and the combination of the two references therefore does not render obvious Applicants' claims.

Consequently, none of *Kuroda et al.*, *Tsukamoto*, or *Bae et al.*, or any combination thereof, discloses or suggests a hot-rolled wire rod as claimed by Applicants and having the critical mass % ranges of the components, as well as satisfying all 4 mechanical property limitations (i.e., TS_{AV}, TS_{σ}, RA_{AV}, RA_{σ}).

Claim 18

New claim 18 requires a double step cooling process wherein: (i) a first cooling step is performed at an average cooling rate of 8 to 20°C/sec in a temperature range of from 900 to 670°C; and (ii) a second cooling step is performed at an average cooling rate of 1 to 5°C/sec in a temperature range of from 670 to 500°C. This double step cooling process allows for the resulting wire rod to have the mechanical properties as required by the claims (e.g., TS_{AV} and wire drawability) (specification: page 18, lines 12-14). In contrast, when single-step cooling is used, lower strength and ductility occurs and wire drawability is poor (specification: page 18, lines 20-23).

As evidence of a difference in product properties resulting from a two-step cooling process as claimed, the current specification describes three cooling methods (A, B, C) used during the preparation of Sample Nos. 1-21 (see page 25, lines 7-19, and present amendment; and Table 1); the methods are as follows: (i) <u>method A</u> involves a <u>two step</u> cooling where the

first step is performed at an average cooling rate of 10°C/sec in the temperature range of 900-670°C, and the second step is performed at an average cooling rate of 5°C/sec in the temperature range of 670-500°C; (ii) method B involves one step of cooling at an average cooling rate of 5°C/sec in the temperature range of 900-500°C; and (iii) method C involves one step of cooling at an average cooling rate of 2°C/sec in the temperature range of 900-500°C. Method A falls within the double step cooling process as claimed (see claim 1), and methods B and C are for comparison purposes.

As can be seen in Table 1, Sample Nos. 15-21 used cooling method C and resulted in wire with low RA_{AV} (30-34), high RA_{σ} (5.6-8.8), and poor wire drawability (high breakage frequency of 15-35) (see also, specification: page 27, line 20, to page 28, line 4). Also, Sample Nos. 8-14 of Table 1 used cooling method B and resulted in poor wire drawability (high breakage frequency of 15-20) and some instances of high RA_{σ} (4.2, 4.7) (see also, specification: page 27, lines 9-19).

In contrast, Sample Nos. 1-4 of Table 1 used the double-step cooling method A (within the double step cooling process as claimed) and resulted in high RA_{AV} (38-42), low RA_{σ} (1.5-3.6), and good wire drawability (no wire breakage at 1.2 mm, and low breakage frequency of 5 at 0.9 mm). This two step cooling process is within the claimed two step cooling limitation and provides for enhanced wire properties.

Kuroda et al. disclose a spring steel and a process for making the spring steel into wire rods for springs (Abstract) wherein the steel is hot-rolled and then cooled "at a rate of 1-4°C/sec in the range from Ps point+15°C to Pf point-15°C (Ps point is the temperature at which pearlite transformation starts, and Pf is the temperature at which pearlite transformation ends)" (col 5, lines 5-12). *Kuroda et al.* also discloses hot-rolling steel followed by cooling "at a rate of 0.1-10°C/sec" (col. 5, lines 49-52). Clearly, *Kuroda et al.* do not disclose or suggest Applicants' double step cooling process as required by the claims.

Furthermore, *Kuroda et al.'s* first disclosed one-step cooling process is similar to that described by Applicants' as method C and the second disclosed one-step cooling process can be considered similar to Applicants' method C or B. Accordingly, since *Kuroda et al.* do not disclose or suggest Applicants' double step cooling process which results in the improved mechanical properties as discussed above, *Kuroda et al.* cannot disclose or suggest Applicants' hot-rolled wire rod, having the claimed mechanical properties, obtained by the double step cooling process.

In addition, *Tsukamoto* discloses a wire of a high-carbon steel (Abstract) produced in part by a three stage thermo-mechanical treatment wherein: (i) stage 1 includes cooling, after patenting treatment, at "a cooling rate of 170°C/sec or higher and normally 190°C/sec or higher" (col. 4, lines 17-27 and 59-62); (ii) stage 2 includes another cooling, after austenitization, by "cooling to 600°C at a cooling rate of 20°C/sec" (col. 6, lines 3-12); and (iii) stage 3 includes no disclosure with respect to cooling temperatures or rates (col. 6, line 27, to col. 7, line 25). *Tsukamoto's* rapid cooling step of 170°C/sec or higher is well outside the scope of Applicants' first rapid cooling step of 8 to 20°C/sec. Furthermore, *Tsukamoto's* "slow" cooling step of 20°C/sec is well outside the scope of Applicants' second slow cooling step of 1 to 5°C/sec. Accordingly, *Tsukamoto* does not disclose or suggest Applicants' double step cooling process as required by the claims.

Moreover, *Tsukamoto's* wire does not have the mechanical properties as claimed by Applicants' because of the difference is cooling methods. This is evidenced by *Tsukamoto's* disclosure that a tensile strength of 400 kgf/mm^2 (= 3922 MPa) or higher is obtained by the disclosed method (see col. 2, lines 43-48; col. 3, lines 8-14; col. 8, lines 48-55), which is well outside Applicants' claimed range (912-1300 MPa).

Additionally, *Bae et al.* disclose a method for manufacturing wire rods and steel wire (Abstract) wherein, after hot-rolling a billet, the billet is cooled at a cooling rate of 10-

30°C/sec (Abstract; col. 4, lines 2-3; col. 6, lines 28-29). *Bae et al.* is silent with respect to a second cooling step. Accordingly, Bae et al. do not disclose or suggest Applicants' double step cooling process as required by the claims.

Furthermore, *Bae et al.'s* wire does not have the mechanical properties as claimed by Applicants' because of the difference is cooling methods. This is evidenced by *Bae et al.'s* disclosure that a tensile strength of more than 200 Kg/mm^2 (= 1961 MPa) is obtained by the disclosed method (see col. 3, lines 39-44; col. 6, lines 18-23), which is well outside Applicants' claimed range (912-1300 MPa).

Lastly, since none of *Kuroda et al.*, *Tsukamoto*, or *Bae et al.*, alone or in combination, disclose or suggest Applicants' double step cooling process which results in the improved mechanical properties as discussed above, these references cannot disclose or suggest Applicants' hot-rolled wire rod, having the claimed mechanical properties, obtained by the double step cooling process. Accordingly, Applicants' claim 18 is not rendered obvious by the art of record.

Conclusion

Applicants submit that all now-pending claims are in condition for allowance. Applicants respectfully request the withdrawal of the rejections and passage of this case to issue.

Respectfully submitted,

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